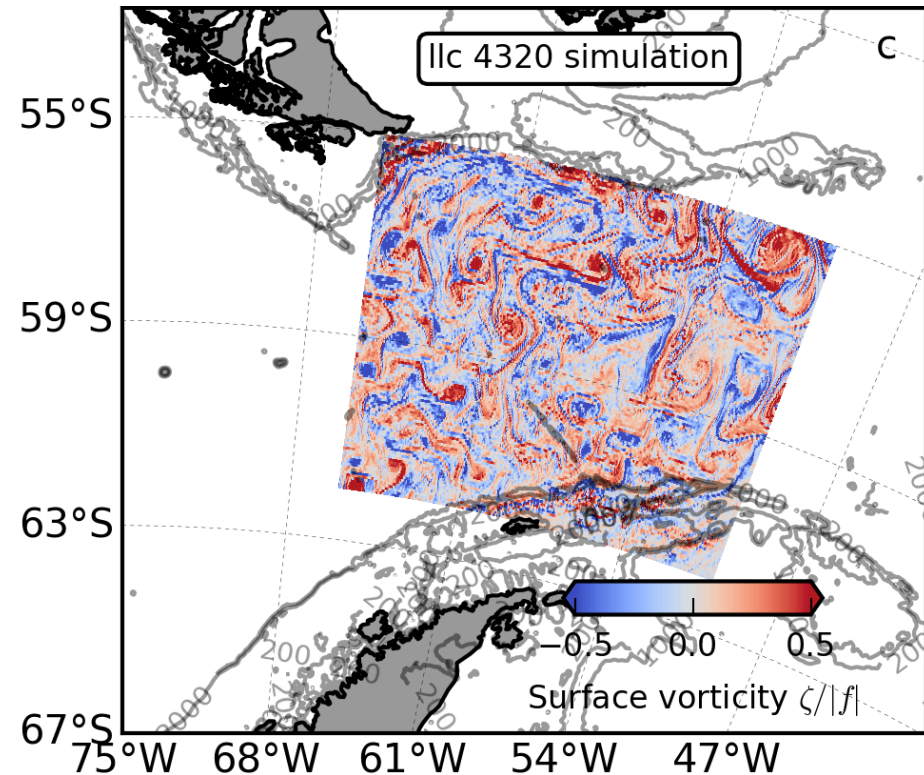


Techniques for Reconstruction & Assimilation of SWOT Ocean Observations

- Gille/Cornuelle/Mazloff/Villas Boas (US) - *Assimilation and interpretation of high-wavenumber variability in the ocean for SWOT*
- Lapeyre/Klein/Ponte/Chapron/Morrow (FR) – *New dynamical tools for SWOT data*
- Le Traon/Benkiran/Dibarboure/Rémy (FR) - *Developing an Effective assimilation of SWOT data in Mercator Ocean Systems (DESMOS)*
- Heimbach/Wunsch/Ferrari (US) - *Evolving global ocean state estimation*

Core objectives: How do we map SWOT data?

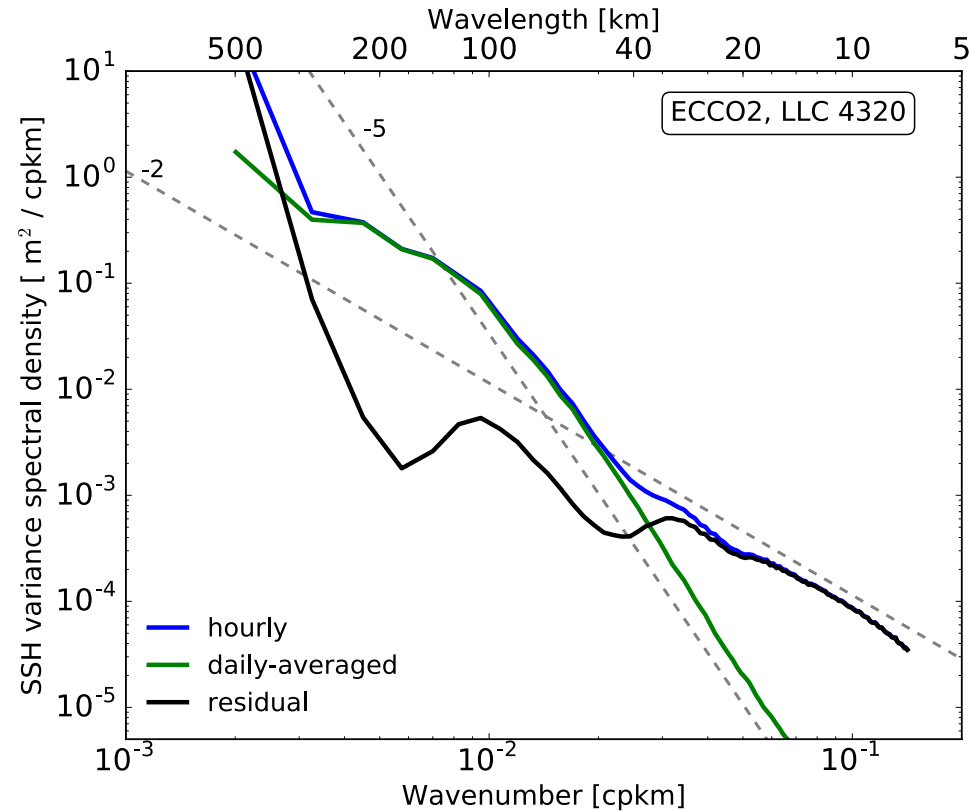
- SWOT is a departure from nadir altimetry, with higher spatial resolution, but no real gain in temporal resolution
- Users desire gridded products.
- How do we use SWOT + additional data and dynamical understanding to generate usable mapped fields?



1/48° MITgcm simulation
(Rocha et al, JPO, 2016)

The Challenges

- Mismatch between high-spatial resolution and coarse temporal resolution
- Multiple contributors to signal:
 - Geostrophic motions
 - Tides
 - Internal waves
 - Surface gravity waves
 - Noise



1/48° MITgcm simulation
(Rocha et al, JPO, 2016)

Commonalities to our approaches: Using data in conjunction with dynamics to determine ocean state

- Data from multiple sources (SST, nadir altimetry, elephant seals)
- Dynamics (distinguishing balanced and unbalanced motions, waves, surface quasi-geostrophy, tidal processes, etc.)
- Assimilation, dynamical interpolation

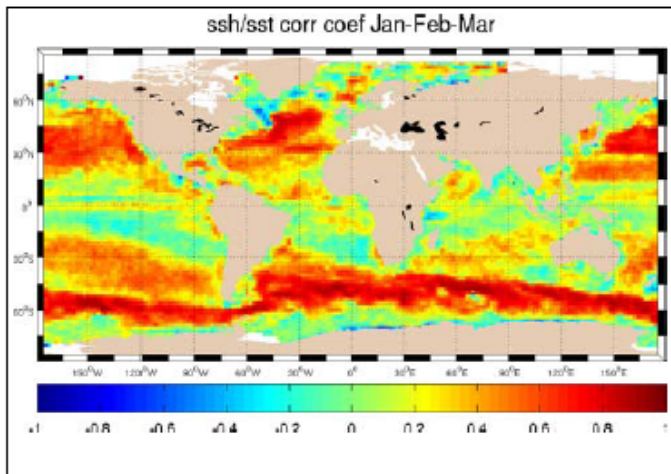
Lapeyre et al: Main questions addressed by the project team

- Which dynamical regime affects the SSH signal?
 - Relation with other tracers (SST)
 - Separation of balanced from unbalanced dynamics (e.g. internal tides)
- Development of reconstruction tools at submesoscales
 - Allow computation of relative vorticity and vertical velocity
 - Comparison with other methods in idealized test-cases or in observations

Lapeyre et al: 1st Workpackage

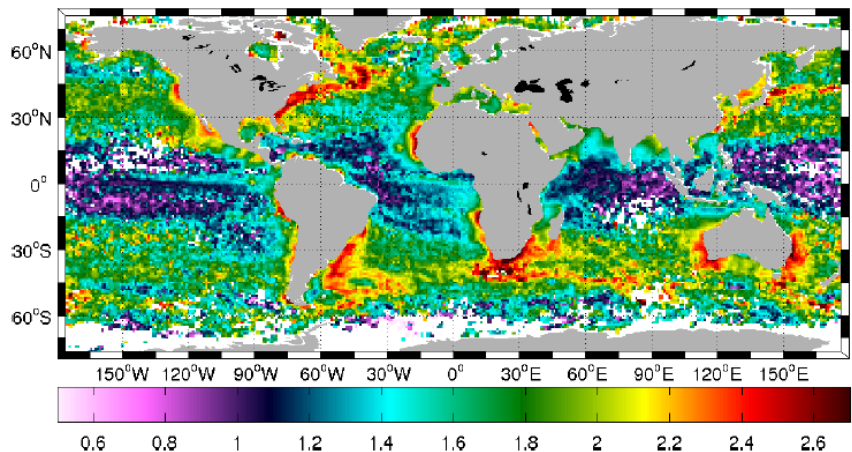
Dynamical interpretation of submesoscale signal

- Joint spectral analysis of satellite signals (SSH, SST...)
 - E. Autret and B. Chapron
- Characterization of the dynamical regimes in the ocean :
QG vs SQG dynamics (S. Berti and G. Lapeyre)



SST/SSH correlation
at mesoscales

(Autret and Chapron)

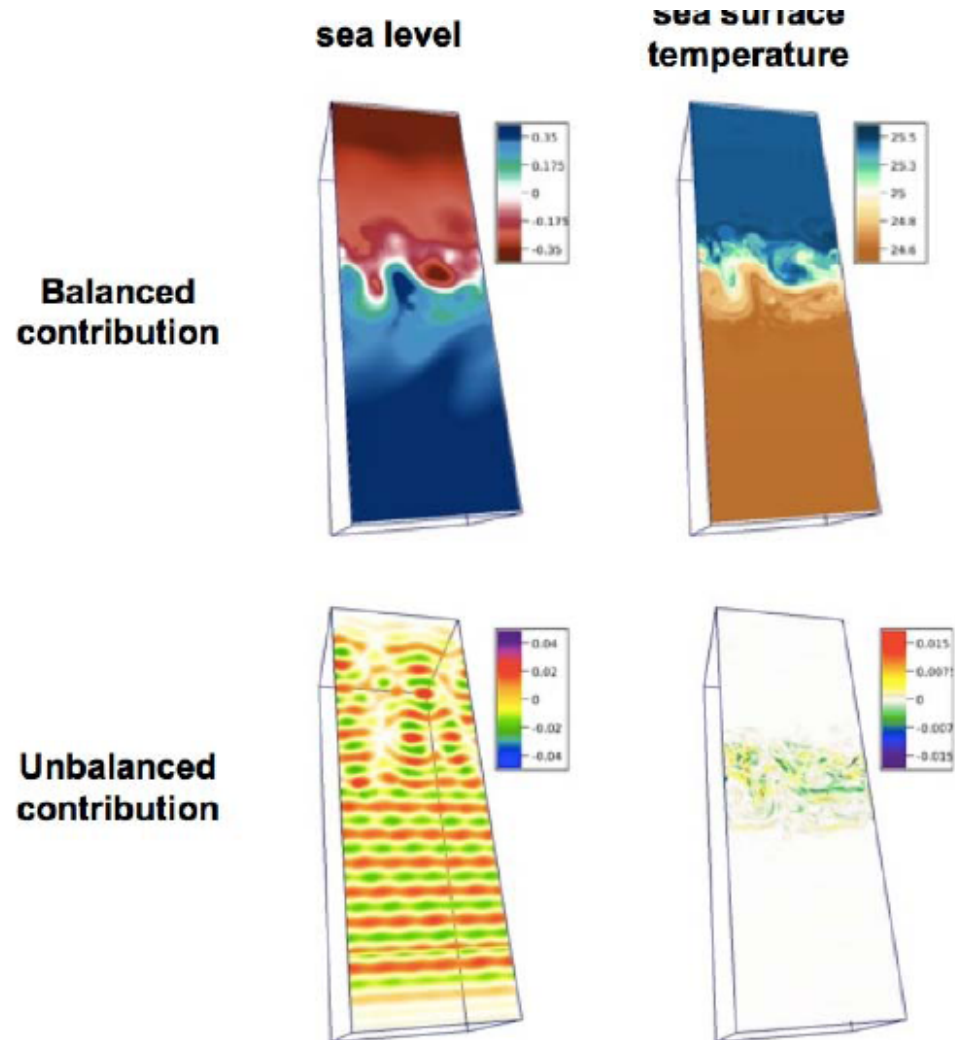


SST spectral slope

Lapeyre et al: 1st Workpackage

Dynamical interpretation of submesoscale signal

- Extraction of the internal tide signal in the SSH signal
 - A. Ponte and P. Klein



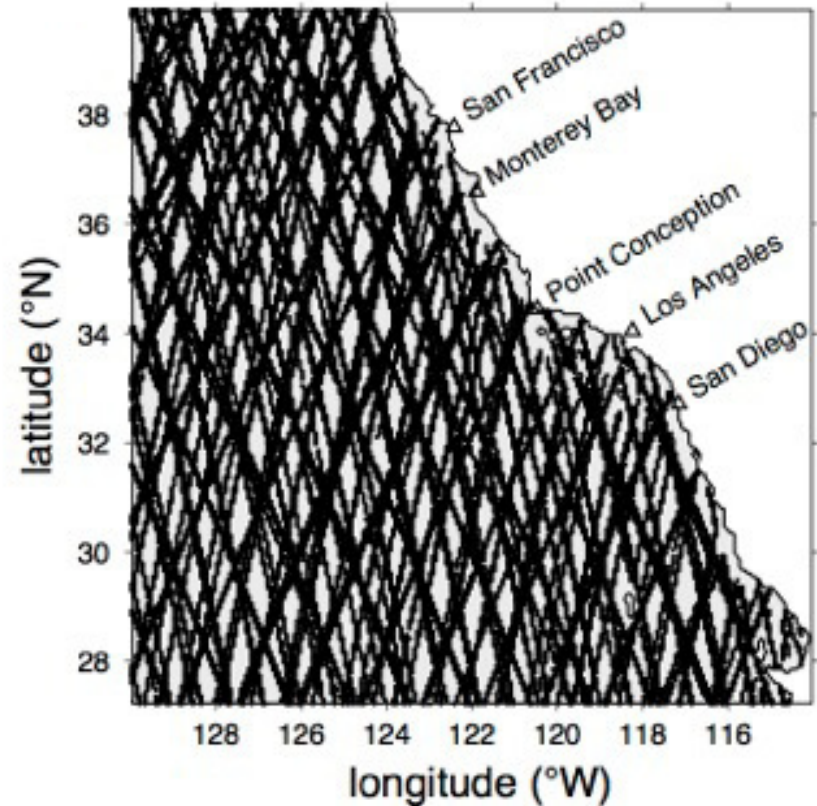
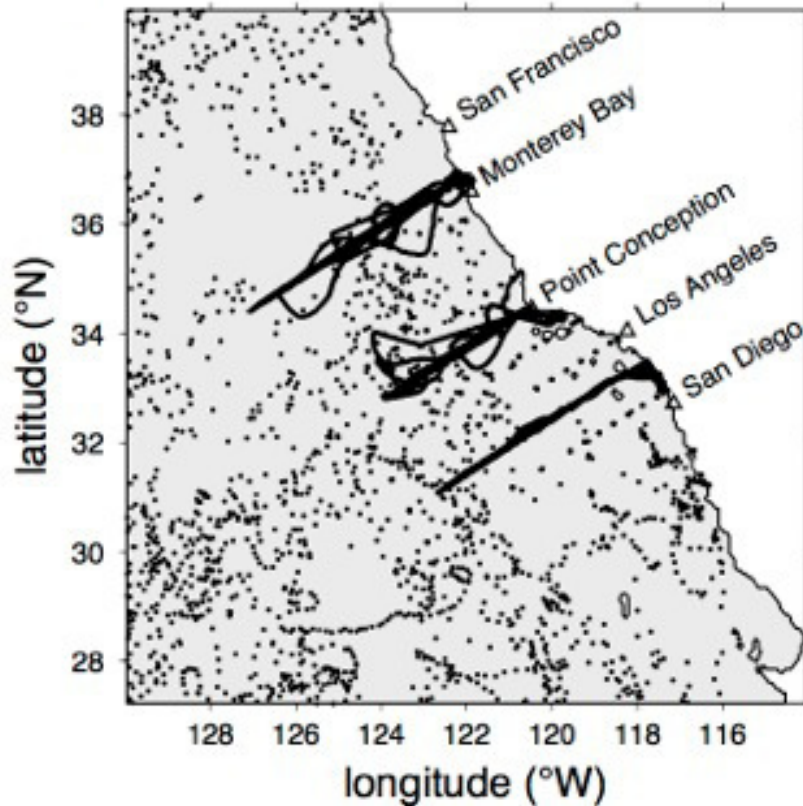
Lapeyre et al: 2nd WorkPackage:

Dynamical reconstructions of submesoscales

- Filling the temporal gaps with dynamical interpolation
 - M. Rogé, R. Morrow, C. Ubelmann
- Reconstruction of the potential vorticity signal from surface signals and Argo data
 - P. Klein, A. Ponte, P. Rivière
- Coupling Lagrangian techniques of reconstruction of fine scales of tracer with the SQG balance
 - S. Berti and G. Lapeyre
- Using new sets of captors (e.g. T/S from elephant seal trajectories)
 - P. Rivière and P. Klein

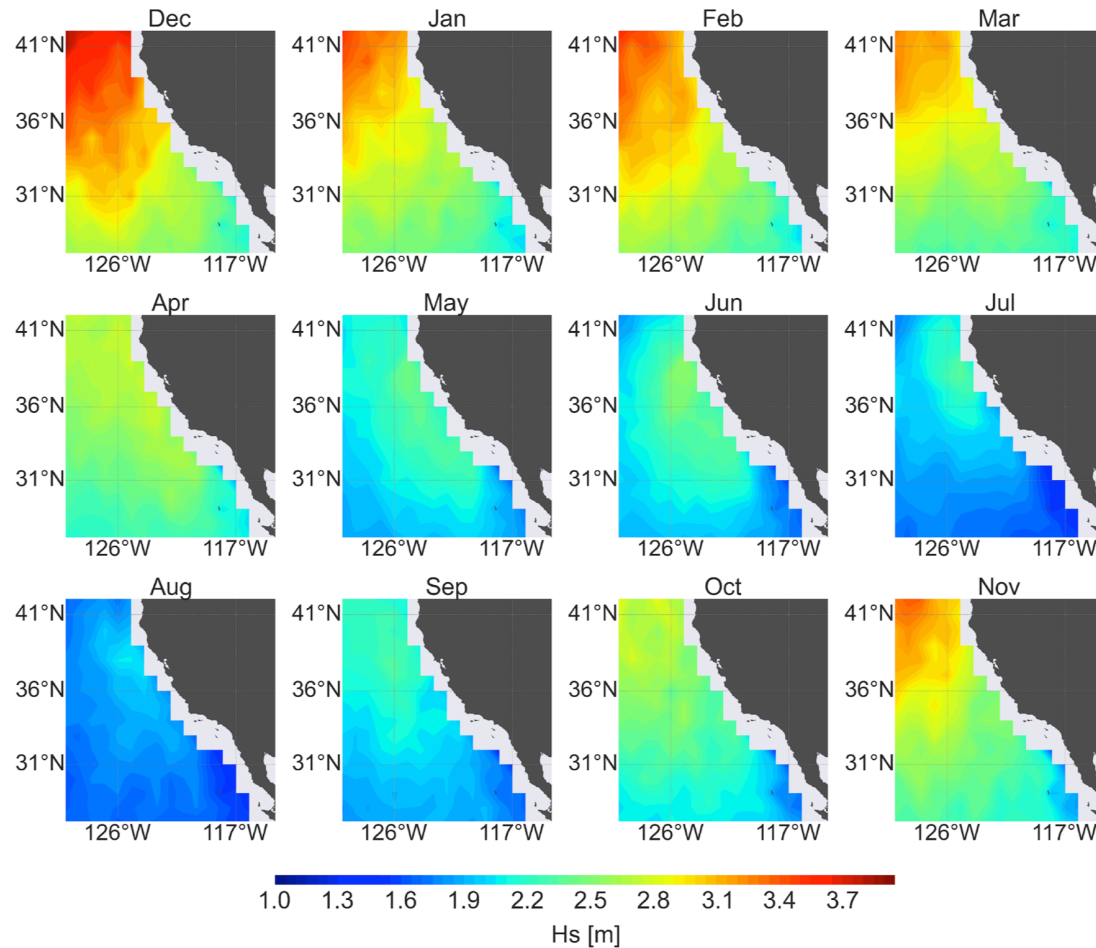
See presentation on Wednesday
splinter session

Gille et al: California Current testbed



- Enable:
- Tides (previously tested by Ponte)
 - Waves (WaveWatch III)
 - Biogeochemistry (if helpful, BLING)

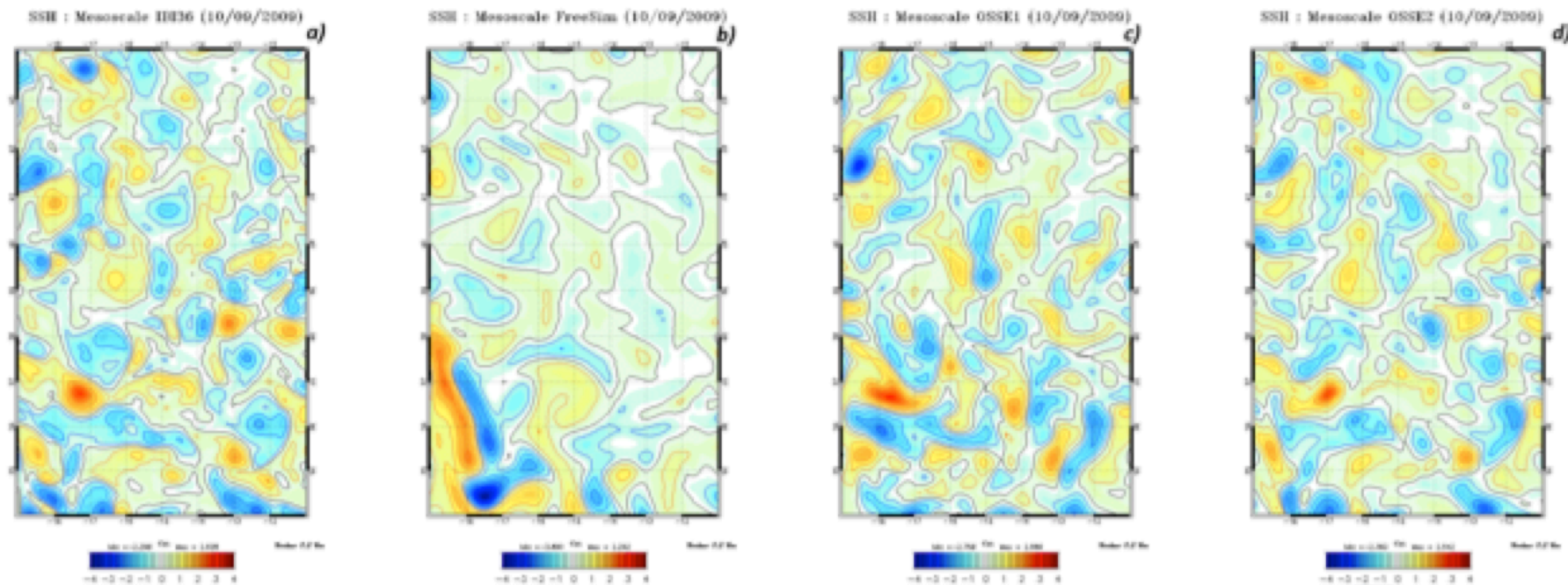
Gille et al: California Current waves



Drivers of seasonal cycle in wave climatology

- Role of wind forcing
- Role of ocean currents

Impact on the small mesoscale signals (wavelengths < 200 km)



Truth

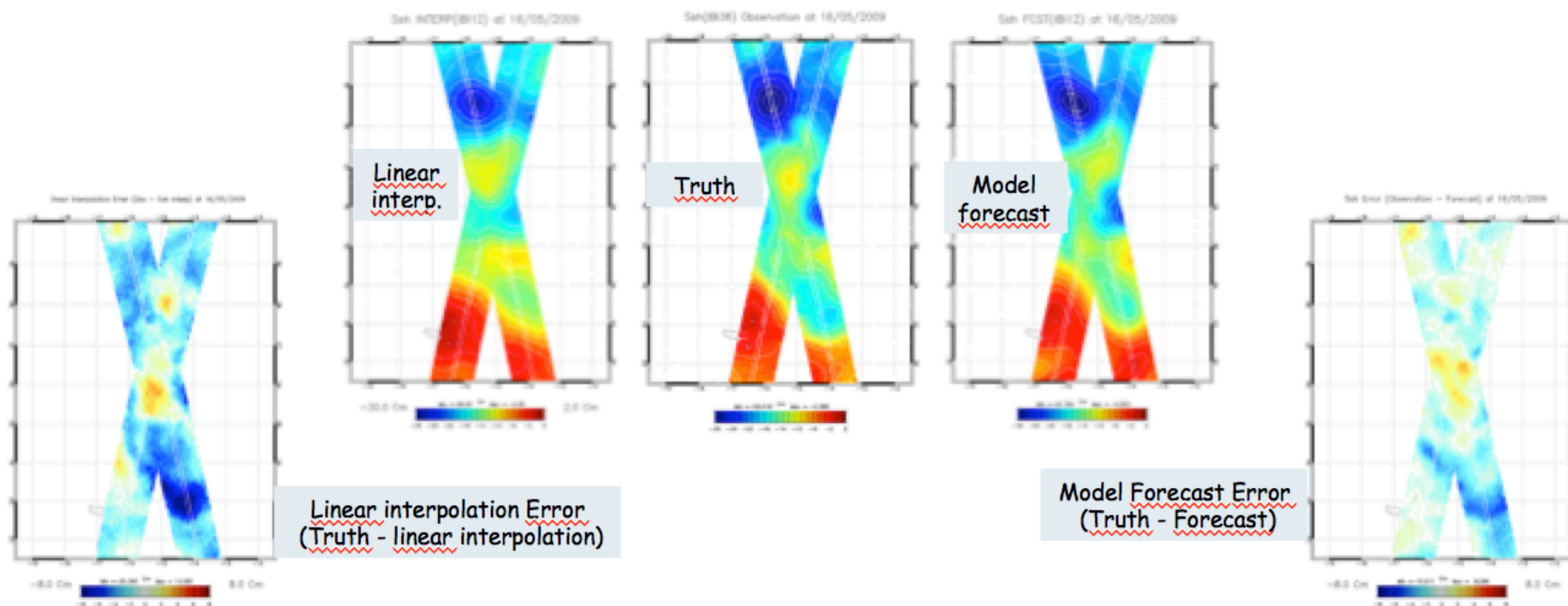
Free Run

3 altimeters

SWOT

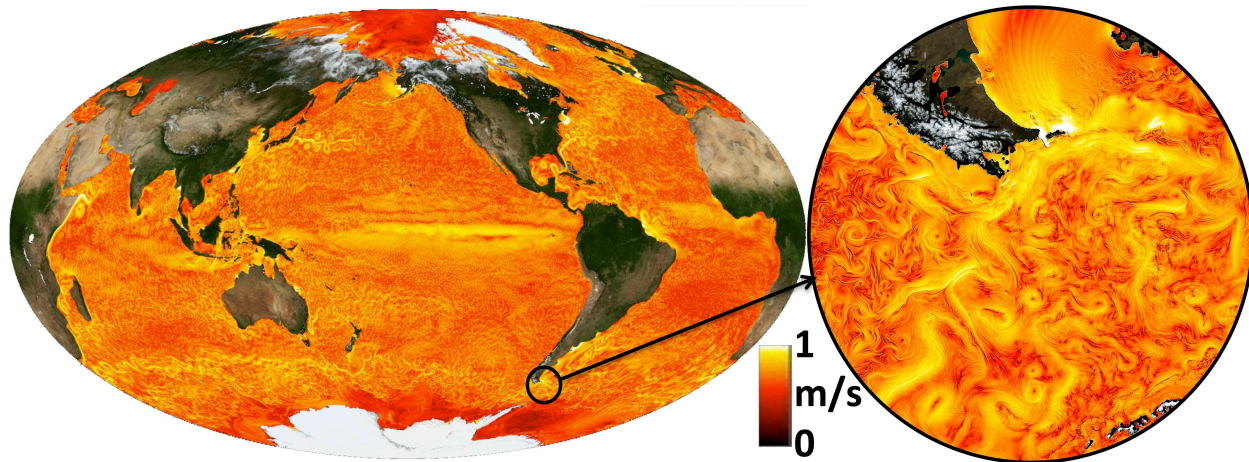
Is the model able to act as a dynamical interpolator of SWOT data ?

A simple example: Estimate SSH just at mid time between two successive swaths through (simple) linear interpolation (using past and future data) and compare with 5-day model forecast (assimilation of past data only).



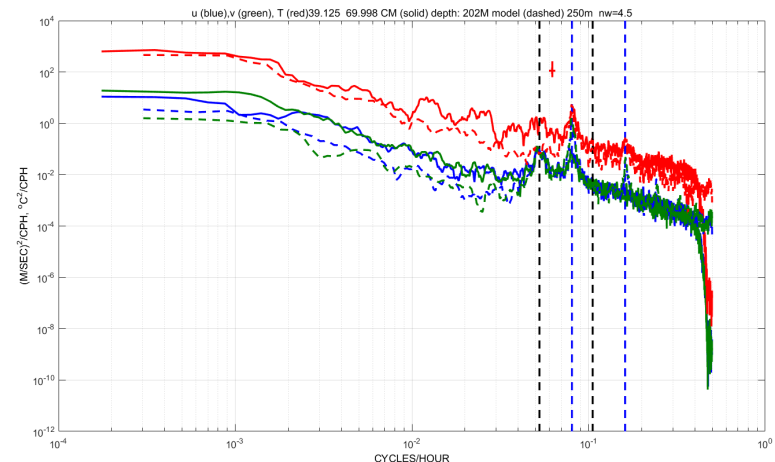
Ferrari et al: High-resolution simulations

Validation of regional (open boundaries) and global high-resolution simulations against observations of surface kinetic energy and SSH



↑
Global MITgcm simulation run by Hill and Menemenlis at 1km resolution

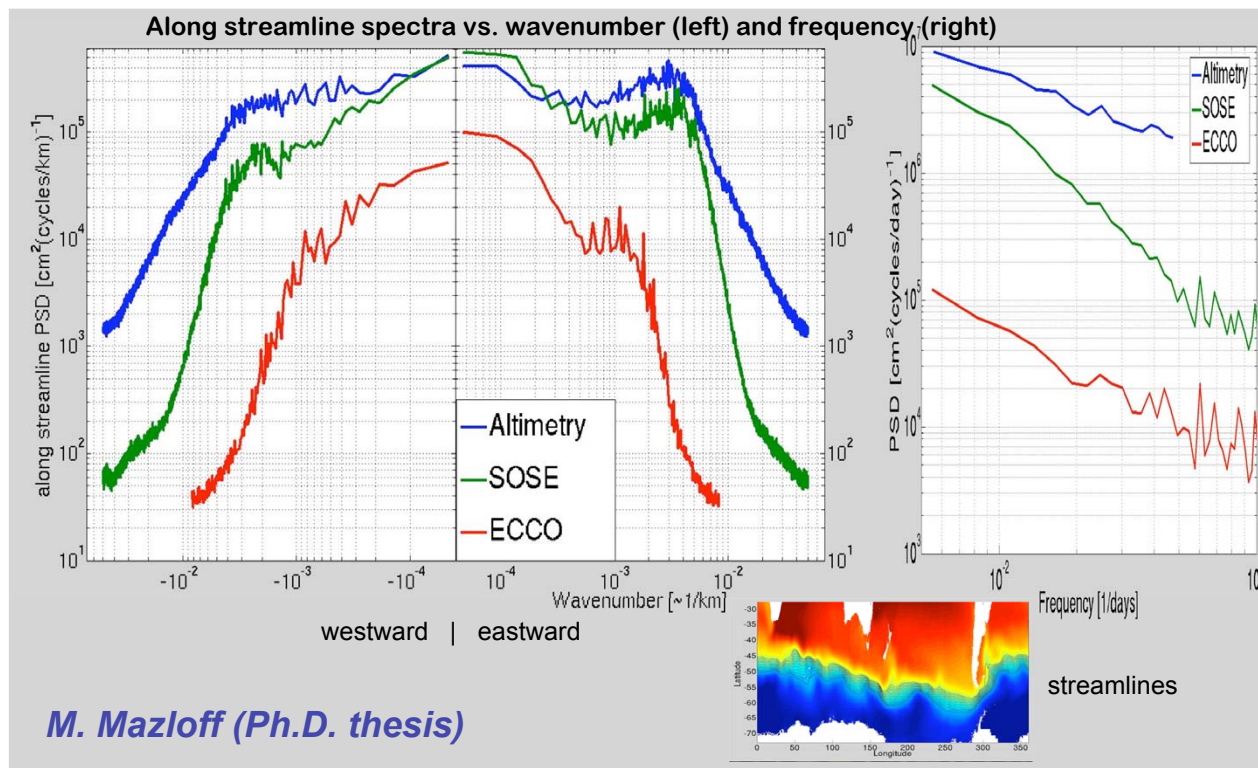
Comparison to observed frequency spectra →



Ferrari et al: SWOT state estimate

Twin high-resolution experiment, validated against observation, will be used to test whether assimilation of wide-swath SSH retrieval every 20 days leads to substantial improvements of state estimate

Eddy permitting state estimation in the Southern Ocean (cont'd)



Summary: complementary approaches

- Lapeyre et al: dynamical tools
- Gille et al: regional 4d-variational assimilation in ECCO, including tides and surface waves
- Le Traon et al: assimilation into Mercator Ocean and Copernicus Marine Environment Monitoring Service, including pre-processing issues (via the SSALTO/DUACS processing chain) [global and regional high-resolution models].
- Ferrari/Heimbach et al: global and regional 4d-variational assimilation in ECCO

